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NG LABORATORIES INC.

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SYSTRON DONNER

INSTRUCTION MANUAL

VIKING LABORATORIES INC.

MODEL 420
FUNCTION GENERATOR

MODEL 421
SWEEP/FUNCTION
GENERATOR

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SYSTRON DONNER CORPORATION

CONCORD INSTRUMENT DIVISION
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FSCM No. 52542

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VIKING LABORATORIES INC.

SYSTRON DONNER
CORPORATION

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Every Systron-Donner instrument is carefully inspected and is in perfect working order at the time of shipment. Each instrument should be checked as soon as received. If the unit is damaged in any way, or fails to operate, a claim should immediately be filed with the transportation company.

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Whenever a Systron-Donner instrument requires service, the nearest Systron-Donner representative should be contacted; all representatives will provide immediate service or arrange factory returns when necessary.

Please specify both model and serial number in all correspondence concerning Systron-Donner instruments. Address all inquiries on operation or applications to your nearest sales representative; or, Sales Manager, Concord Instrument Division, Systron-Donner Corporation, 10 Systron Drive, Concord, California 94518.

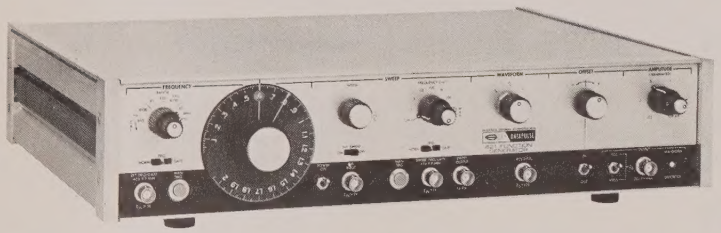
VIKING LABORATORIES INC.

DATAPULSE DIVISION
SYSTRON DONNER

ADVANCE SPECIFICATIONS

MODEL 421

20 MHz SWEEP/ FUNCTION GENERATOR



* 20 MHZ FREQUENCY
* INTERNAL SWEEP
* CALIBRATED SWEEP LIMITS
* FREQUENCY MODULATED
* 80 dB ATTENUATION
* 20 V P–P OUTPUT
* 10 V DC OFFSET
* TRIGGER & GATE MODES

SPECIFICATIONS

FREQUENCY

Range–2 Hz to 20 MHz in 7 decade ranges.
Accuracy– $<\pm 2\%$ of reading to 2 MHz. $\simeq \pm 10\%$ of range to 20 MHz.
Stability– $<\pm 0.1\%$ for 1 hour. $<\pm 0.5\%$ for 24 hours.
Vernier–Approximately 3% of dial reading.

FREQUENCY MODULATION

Range: >200:1.
Sensitivity–+5 volts required for full voltage control.
Input Frequency–0 to 50 kHz.
Input Impedance–>5 kilohms.

MODES OF OPERATION

Normal–Free running.
Triggered–Produces one cycle when manual pushbutton is depressed or +1 volt trigger is applied.
Gated–Produces one burst for duration of manual pushbutton depression or duration of +1 volt gate.
Sweep–Main generator is frequency modulated by internal sweep generator.

MAIN OUTPUT

WAVEFORMS–Sine, square and triangle.

Sine Distortion–<0.8% to 20 kHz. No harmonic>-35 dB to 200 kHz. No harmonic>-30 dB to 2 MHz. No harmonic >-25 dB to 20 MHz.
Symmetry–>98.5% to 2 MHz.
Square Wave Aberrations–Typically 5%.
Square Wave Transition Times–Typically 15 ns.

AMPLITUDE–20 V p–p maximum, open circuit. 10 V p–p maximum, into 50 ohms.
Attenuation–80 dB in five 10 dB steps plus continuously variable 30 dB vernier.
Impedance–50 ohms or 600 ohms front panel switch selectable.
Sine Frequency Response–± 0.1 dB to 2 MHz. ± 1 dB to 20 MHz.

DC OFFSET–± 10 V into open circuit. ± 5 V into 50 ohms. Combination of dc offset and signal limited to ± 10 volts when terminated in 50 ohms.

DISTORTION INDICATOR–Indicates when combination of dc offset and signal have been set to $>\pm 10$ volts.

SYNC OUTPUT–1 volt minimum square wave (0 volt baseline) from 50 ohms.

SWEEP GENERATOR

Frequency–0.01 Hz to 100 kHz in 7 decade ranges.
Width–>200:1.
Width Accuracy–10% of reading to 2 MHz. $\simeq$15% of range to 20 MHz.
Output–5 V p–p from 600 ohms.

MODES OF OPERATION

Normal–Free running sawtooth.
Triggered–One cycle for each manual pushbutton depression or trigger input.
Gated–Output is activated for duration of pushbutton depression or gate input.
Trigger/Gate Input– >+1 V p–p. Input impedance is $\simeq$ 1 kilohm.

MISCELLANEOUS

POWER REQUIRED–Approximately 65 W at 105–125/-210–230 V and 50 to 60 Hz ac.
WEIGHT–Instrument (net) 16 lbs. Gross (shipping) 20.5 lbs.
DIMENSIONS–16¾" W x 3½" H x 14-5/8" D. Cabinet less knob projections 13-1/8" D.
PRICE–$895.00 f.o.b., Culver City, California.

NOTE: Unless otherwise specified, all specifications apply from 0.2 to 2 on the frequency dial with the vernier in the "Cal" position at 25° C $\pm 5^{\circ}$ C.

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IMPORTANT! SEE ADDENDA FOR CHANGES TO THIS SECTION.

SECTION II

CONTROLS AND CONNECTORS

Refer to Figure 2-1 for the explanations of the functions of the following controls which are common to the Model 420 and Model 421 Function Generators.

2.1 POWER Switch

Applies ac power to the primary of the power transformer and illuminates the pilot lamp.

2.2 WAVEFORM Selector

Selects sine, square, or triangular wave outputs.

2.3 MAN TRIG Pushbutton

Generates a single cycle of signal (in triggered mode). Generates bursts of the signal (in gated mode) for as long as the MAN TRIG pushbutton is depressed.

2.4 FREQUENCY RANGE Selector

Selects a frequency range (from 2 Hz to 20 MHz) in one of seven decade ranges (10 Hz, 100 Hz, 1 kHz, 10 kHz, 1 MHz, 10 MHz) for sine, square or triangle waves.

2.5 FREQUENCY RANGE Vernier

A fine adjust potentiometer used to select a specific frequency within the range selected by the FREQUENCY RANGE switch.

2.6 FREQUENCY Dial

A coarse adjust potentiometer used to select a specific frequency within the range selected by the FREQUENCY RANGE switch.

2.7 OFFSET Selector

Selects for offset operation when placed in IN position.

2.8 OFFSET Vernier

Sets dc reference level of output waveform (from 0 to ±10 V open circuit, 0 to ±5 V into 50 ohms).

2.9 Z_O Selector

Selects 50 or 600 ohms output impedance.

2.10 WAVEFORM DISTORTED Indicator

Indicates waveform amplitude exceeds allowable limits (±10 V).

2.11 NORM/TRIG/GATE Switch

Selects one of three possible modes of operation for the main generator. In NORM position the output is continuous. In TRIG position one cycle of output occurs for each trigger signal applied. In GATE position the output continues for the duration of the gate signal.

2.12 AMPLITUDE Control

This control selects the specific attenuator step required to attenuate the signal to the value indicated on the front panel markings.

2.13 OUTPUT 20 V P–P MAX Connector

Connector that supplies sine, square and triangular wave outputs (primary signal outputs).

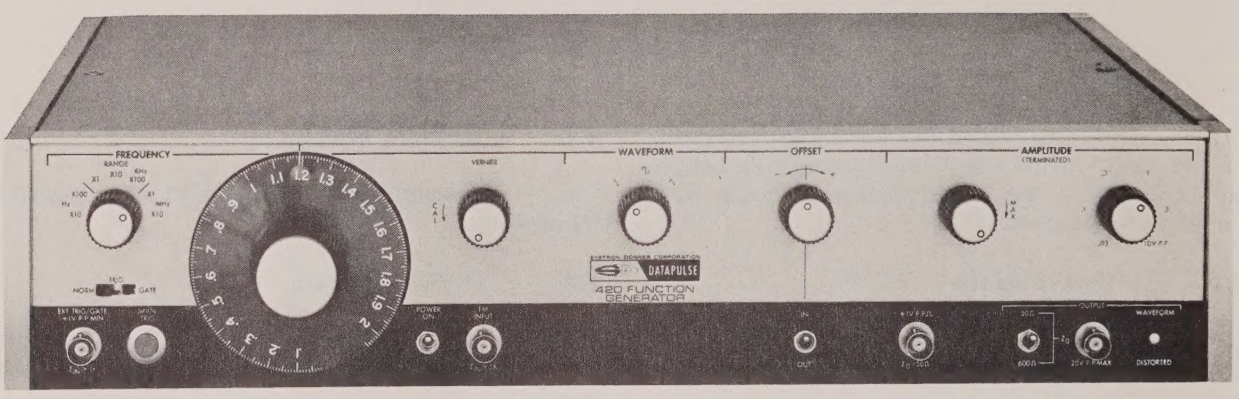


Figure 2-1a. Model 420 Controls and Connectors

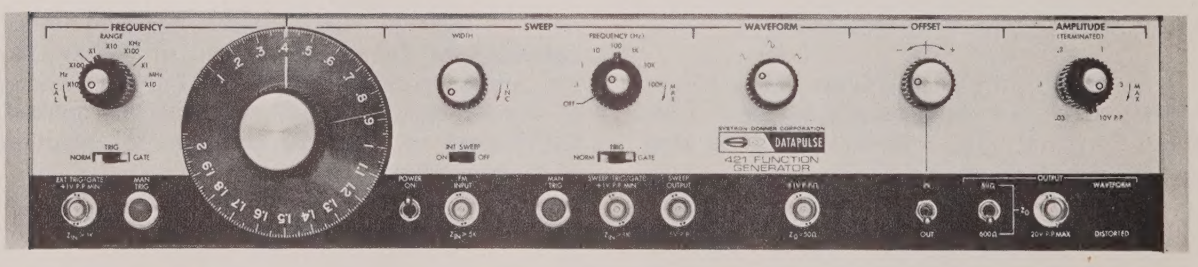


Figure 2-1b. Model 421 Controls and Connectors

2.14 +1 V P–P ⊓ Connector

Connector that supplies square wave output at > 1 V P–P that can be used as a sync signal.

2.15 FM INPUT Connector

Input connector for a frequency modulation signal.

2.16 EXT TRIG/GATE +1 V P–P MIN Connector

Connector for an external gate or trigger signal to be applied to main signal generator.

2.17 115/230 Line Voltage Selector (Back Panel)

Selects the transformer primary configuration for either 115 or 230 volt input.

Refer to Figure 2 - 1b for explanation of the following control functions; these controls are peculiar to the Model 421 Function Generator.

2.18 NORM/TRIG/GATE Selector (Model 421 only)

Selects one of three modes of operation for the sawtooth generator. In NORM position the sawtooth output is continuous. In TRIG position one sawtooth wave occurs for each trigger signal applied. In GATE position the sawtooth output occurs repeatedly for the duration of the gate signal (or for the duration of the internally or externally generated trigger).

2.19 MAN TRIG Pushbutton (Model 421 only)

Generates single sawtooth signals when NORM/TRIG/GATE switch is in TRIG, or bursts of sawtooth signals for the length of time the MAN TRIG switch is depressed or external trigger is applied when the NORM/TRIG/GATE switch is in GATE.

2.20 SWEEP FREQUENCY Selector (Model 421 only)

The sweep frequency switch selects frequencies from 0.1 Hz to 100 kHz in seven decade ranges.

2.21 SWEEP FREQUENCY Vernier (Model 421 only)

Causes the sawtooth generator to generate a sawtooth wave at a particular frequency within the frequency range selected by the SWEEP FREQUENCY switch.

2.22 SWEEP WIDTH Vernier (Model 421 only)

Determines the amplitude of the sweep input to the frequency control in the main generator and therefore the percentage of the main generator frequency that is swept.

2.23 INT SWEEP Switch (Model 421 only)

Causes the frequency of the main generator to be swept over the range determined by the WIDTH controls at the SWEEP FREQUENCY.

2.24 SWEEP TRIG/GATE +1 V P–P MIN Connector (Model 421 only)

Supplies sawtooth sweep outputs to external equipments.

2.25 SWEEP OUTPUT 5 V P–P Connector (Model 421 only)

Supplies sawtooth sweep generator outputs to external equipment.

IMPORTANT! SEE ADDENDA FOR CHANGES TO THIS SECTION.

SECTION III

OPERATION

3.1 OPERATION CHECK

The following procedures provide a brief operational check of the function generator and an introduction to its controls.

3.1.1 Test Equipment Required

The following items of test equipment (or their equivalent) are required to perform functional operational checks on function generators.

a. Systron-Donner Model 7004 Digital Multimeter.

b. Systron-Donner Model 6152 Counter.

c. Datapulse Model 99 Pulse Generator.

d. Tektronix Model 544 Oscilloscope with a 1A2 and 1S1 plug-in units.

e. Tektronix feed-thru 50 ohm termination.

3.1.2 Output Check

The following check verifies that the function generator's sine, square and triangular wave generation circuits are operating correctly.

a. Connect Model 544 oscilloscope vertical amplifier to OUTPUT 20 V P–P MAX connector. Sync oscilloscope at +1 V P–P connector.

b. Set function generator controls as follows:

Control	Setting
NORM/TRIG/GATE selector	NORM
POWER selector	ON
WAVEFORM selector	square (⊓)
FREQUENCY RANGE selector	X10
OFFSET selector	OUT
Z_O selector	50
AMPLITUDE vernier	maximum clockwise

c. Rotate FREQUENCY controls (vernier and dial) from minimum to maximum position. Observe waveform on oscilloscope trace. Waveform frequency shall vary from approximately 2 to 20 Hz.

d. Repeat step (c) with FREQUENCY RANGE switch set to the following positions. Check to see that the indicated frequencies are obtained.

Position	Frequency Range (approximately)
X100 Hz	20 Hz to 200 Hz
X1 kHz	200 Hz to 2 kHz
X10 kHz	2 kHz to 20 kHz
X100 kHz	20 kHz to 200 kHz
X1 MHz	200 kHz to 2 MHz
X10 MHz*	2 MHz to 20 MHz

*Use 1S1 plug-in unit for this range.

e. Repeat step (c) with WAVEFORM switch set first to sine (∿) and then to triangle (⩘).

f. Set AMPLITUDE vernier to maximum counterclockwise.

g. Set OFFSET selector to IN.

h. Rotate OFFSET vernier to maximum counterclockwise.

i. Verify that dc level is >-5.0 V.

j. Rotate OFFSET vernier to maximum clockwise.

k. Verify that dc level is >+5.0 V.

l. Rotate AMPLITUDE vernier clockwise until DISTORTION indicator illuminates.

m. Rotate AMPLITUDE vernier to maximum counterclockwise.

n. Rotate OFFSET vernier control to maximum counterclockwise.

o. Rotate AMPLITUDE vernier clockwise until DISTORTION indicator illuminates.

p. Set OFFSET selector to OUT.

q. Set AMPLITUDE vernier for 20 V p–p waveform.

r. Terminate output into 50 ohm coaxial termination at oscilloscope.

s. Verify that amplitude of displayed signal is 10 V p–p.

t. Set Z_O selector to 600 ohms.

u. Verify that amplitude of displayed signal is approximately 1.55 V peak-to-peak.

3.1.3 Gate Mode Check

a. Set function generator controls as follows:

Control	Position
POWER selector	ON
WAVEFORM selector	triangle (∿)
FREQUENCY RANGE selector	X10K
NORM/TRIG/GATE selector	GATE

b. Connect Model 99 Pulse Generator output connector to function generator EXT TRIG/GATE connector.

c. Set controls on pulse generator for 1 kHz repetition rate, +2 V amplitude.

d. Adjust function generator FREQUENCY controls so that output frequency of pulse generator is less than 1/10 of the output frequency of function generator.

e. Connect Model 544 oscilloscope vertical amplifier to OUTPUT 20 V P–P MAX connector. Sync oscilloscope at +1 V P–P connector.

f. Observe oscilloscope display. There should be a burst of triangle wave for duration of gate input. Disconnect pulse generator.

g. Press MAN TRIG pushbutton. Observe burst of triangle wave for duration of period in which pushbutton is depressed.

3.1.4 Trigger Mode Check

a. Set function generator controls as follows:

Control	Position
POWER selector	ON
WAVEFORM selector	sine (∿)
FREQUENCY RANGE selector	10 kHz
NORM/TRIG/GATE selector	TRIG
FREQUENCY RANGE vernier	maximum counterclockwise
FREQUENCY dial	mid-point

b. Connect Model 544 oscilloscope vertical amplifier to OUTPUT 20 V P–P MAX connector. Sync oscilloscope at +1 V P–P connector.

c. Connect Model 99 Pulse Generator output to function generator EXT TRIG/GATE connector.

d. Set pulse generator controls for 1 kHz output at +3 V level. Observe oscilloscope display. Observe one cycle of output for each pulse generator trigger.

e. Set WAVEFORM selector to square wave (⊓). Disconnect pulse generator.

f. Press MAN TRIG pushbutton and observe oscilloscope. Verify that one square wave appears momentarily on oscilloscope trace each time MAN TRIG pushbutton is depressed.

3.1.5 Sweep Generator Check (Model 421 only)

a. Set function generator controls as follows:

Control	Position
POWER selector	ON
WAVEFORM selector	triangle (∧)
FREQUENCY RANGE selector	X10 kHz
FREQUENCY vernier	CAL
FREQUENCY dial	0.2
OFFSET selector	OUT
Z_O selector	50 OHMS
NORM/TRIG/GATE selector (main generator)	NORM
NORM/TRIG/GATE selector (sweep generator)	NORM
AMPLITUDE vernier	maximum clockwise
AMPLITUDE selector	10 V P–P
SWEEP FREQUENCY selector	1 K
SWEEP FREQUENCY vernier	maximum counterclockwise
SWEEP WIDTH vernier	maximum counterclockwise

b. Connect SWEEP TRIG/GATE +3 V P–P connector to oscilloscope vertical input triggering oscilloscope internally.

c. Verify that repetition rate of sweep generator is approximately 1 kHz.

d. Rotate SWEEP FREQUENCY vernier in clockwise direction and verify that sweep frequency increases.

e. Rotate SWEEP WIDTH vernier in a clockwise direction and verify that width of frequencies swept is increased.

f. Set SWEEP FREQUENCY selector to remaining switch positions; rotate SWEEP FREQUENCY vernier and SWEEP WIDTH vernier at each position of switch. Observe that change occurs in sweep frequency and width as selector is repositioned and vernier is rotated.

g. Set NORM/TRIG/GATE selector to TRIG. Depress MAN TRIG pushbutton and observe one cycle of sweep output on oscilloscope.

h. Set NORM/TRIG/GATE selector to GATE. Depress MAN TRIG pushbutton and observe burst of sweep pulses on oscilloscope during period that MAN TRIG pushbutton is depressed.

i. Set WAVEFORM switch to square wave (⊓).

j. Set SWEEP FREQUENCY vernier and SWEEP WIDTH vernier to maximum counterclockwise position.

k. Expand oscilloscope display for approximately three cycles of square wave.

l. Set SWEEP WIDTH vernier to maximum clockwise position; observe that period of square wave changes from approximately 0.2 Hz to 20 kHz.

IMPORTANT! SEE ADDENDA FOR CHANGES TO THIS SECTION.

SECTION IV

CALIBRATION

4.1 EQUIPMENT REQUIRED

The following items of equipment (or their equivalent) are required to accomplish calibration of the Model 420 and Model 421 Function Generators.

a. Systron-Donner Model 7004 Digital Multimeter.

b. Tektronix Model 544 Oscilloscope with a Type 1A2 Plug-in unit and a Type 1S1 Sampling Plug-in unit.

c. Systron-Donner Model 6152 Counter.

d. Hewlett-Packard Model 334A Distortion Analyzer.

e. Boonton Electronics Model 91H Voltmeter with 100:1 divider and a 50 ohm termination.

NOTE: To ensure maximum performance and long term calibration, no adjustments should be made before the instrument has completed a one-half hour warm-up period. Since the warm-up period is to allow for internal temperature stabilization, the instrument top cover should be slid back only while actual adjustments are being made.

4.1.1 Preliminary Control Positioning

Prior to performing calibration procedures, position the following controls to the indicated positions.

4.1.1.1 Model 420/421 Controls

Control	Position
NORM/TRIG/GATE selector	NORM
FREQUENCY vernier	CAL
WAVEFORM selector	sine (∿)
OFFSET selector	OUT
Z_O selector	50 OHMS
AMPLITUDE vernier	maximum clockwise
ATTENUATOR	10 V P–P

4.1.1.2 Model 421 Controls (only)

Control	Position
INT SWEEP selector	OFF
NORM/TRIG/GATE selector	NORM
FREQUENCY (HZ)	OFF

4.2 POWER SUPPLY CALIBRATION

CAUTION

In the event of component failure on the power supply board, it is mandatory that potentiometers R555 and R556 be set to approximately center position to avoid destruction of component Z551.

a. Set digital multimeter controls for AUTO measurement.

b. Connect the digital multimeter voltage probe to +30 V test point TP5A and

connect digital multimeter common terminal to ground.

c. Apply power to instrument by setting POWER switch to ON. Allow 30 minute (minimum) warm-up period before proceeding.

d. Observe digital multimeter and adjust potentiometer R513 for +30 ±0.1 V dc.

e. Connect digital multimeter voltage probe to -30 V test point TP5D. Observe digital multimeter and adjust potentiometer R543 for -30 ±0.1 V dc.

f. Connect the digital multimeter voltage probe to +15 V test point TP5B. Observe digital multimeter and adjust potentiometer R555 for +15 ±0.1 V dc.

g. Connect digital multimeter voltage probe to -15 V test point TP5C. Observe digital multimeter and adjust potentiometer R556 for -15 ±0.01 V dc.

NOTE: There is an interaction between the adjustments of potentiometers R555 and R556. Therefore, following step (g), recheck the +15 V supply output and if it is not correct, readjust R555 and R556 until correct supply calibration is achieved.

4.3 OSCILLATOR CALIBRATION

a. Set instrument controls as follows:

Control	Position
FREQUENCY RANGE selector	X10 HZ
FREQUENCY RANGE vernier	CAL
NORM/TRIG/GATE selector	NORM
WAVEFORM selector	triangle (∿)
OFFSET selector	OUT
OFFSET vernier	0
AMPLITUDE vernier	maximum
AMPLITUDE attenuator	10 V P–P
Z_O selector	50 OHMS

b. Set oscilloscope controls as follows:

Control	Position
INPUT COUPLING selector	DC
VOLTS/DIV selector	0.2
TIME BASE selector	10 MS

c. Connect oscilloscope input to instrument +1 V P–P connector.

d. Observe oscilloscope display and verify that oscillator is operative as indicated by presence of square wave.

NOTE: The procedures in paragraph 4.3, steps (e) through (k) should be accomplished only when the FREQUENCY dial or FREQUENCY potentiometer R1 have been replaced.

e. Set digital multimeter controls for AUTO measurements.

f. Connect digital multimeter test probe to arm S of FREQUENCY potentiometer R1.

g. Rotate potentiometer R1 until digital multimeter indicates 28.18 V.

h. Install dial on potentiometer shaft and set dial to 2. Tighten Allen screws on dial. Recheck voltage at arm S of R1 to ensure that the dial has been properly installed.

i. Connect digital multimeter test probe to test point TP1A and adjust potentiometer R9 for -0.136 V.

j. Disconnect oscilloscope from +1 V P–P ⊓ connector.

k. Connect counter to +1 V P–P ⊓ connector.

l. Set counter controls for period measurement and set counter range selector for 100 ms.

m. Set FREQUENCY dial to 2 and observe counter indication. It should be 50 ms. If not, adjust potentiometer R137 for 50 ms (50,000 μs) indication on counter. (50 ms = 50,000 μs = 20 Hz.)

n. Set FREQUENCY dial to 0.2. Observe counter indication. It should be 500 ms. If not, adjust potentiometer R9 to obtain this indication.

o. Set FREQUENCY dial to 2. Observe counter indication. It should be 50 ns. If not, readjust R137. If correct adjustment cannot be achieved proceed to next step.

p. Two examples are provided. The principle involved is to overadjust R9 by 10% to compensate for its overall effect on calibration of the dial.

EXAMPLE 1 – Counter indicates 550 ms with FREQUENCY dial positioned at 0.2. Adjust potentiometer R9 until counter indicates 495 ms. Set FREQUENCY dial to 2. Note that counter now indicates 49.5. Adjust R137 until counter indicates 50 ms. Position dial to 0.2 and observe that counter indicates 500 ms.

EXAMPLE 2 – Counter indicates 450 ms with FREQUENCY dial positioned at 0.2. Adjust potentiometer R9 until counter indicates 505 ms. Set dial to 2. Observe that counter indicates 50.5 ms. Adjust potentiometer R137 for 50 ms. Set dial to 0.2 and observe that counter now indicates 500 ms.

q. Set FREQUENCY RANGE selector to X100 HZ.

r. Set FREQUENCY dial to 2. Counter should indicate 5 $\pm$0.1 ms.

s. Set FREQUENCY dial to 0.2. Counter should indicate 50 $\pm$1 ms.

t. Set FREQUENCY RANGE selector to X1 kHz.

u. Set FREQUENCY dial to 2. Counter should indicate 500 ms $\pm$10 ms.

v. Set FREQUENCY dial to 0.2. Counter should indicate 5 ms $\pm$0.1 ms.

w. Set FREQUENCY RANGE selector to X10 kHz.

x. Set FREQUENCY dial to 0.2. Counter should indicate 50 μs $\pm$1 μs.

y. If instrument cannot be correctly calibrated on either X1 K or X10 K range, adjust potentiometer R9 and/or R137, then repeat steps (k) through (p). If correct adjustment cannot be achieved at this point adjust capacitor C112 and/or C113.

4.4 CAPACITOR ADJUSTMENT

a. Set FREQUENCY RANGE selector to 10 MHz.

b. Set RANGE dial to 2.

c. Connect counter Rate A input to +1 V P–P ⊓ connector.

d. Set counter controls for frequency measurements as follows:

Control	Setting
FUNCTION selector	RATE A
Frequency Resolution pushbuttons	10 Hz

e. Observing counter indication, adjust capacitor C116 for 20 MHz ±2 MHz.

f. Set FREQUENCY RANGE selector to 1 MHz.

g. Observing counter indication, adjust capacitor C132 for counter indication of 2 ±0.02 MHz.

h. Set FREQUENCY RANGE selector to 10 MHz.

i. Adjust capacitor C116 for counter indication of 20 ±2 MHz.

j. Set FREQUENCY RANGE selector to 100 kHz.

k. Adjust capacitor C115 for counter indication of 200 ±2 kHz.

NOTE: There is an interaction between capacitors C116, C132 and C115 adjustments. Therefore, some readjustments may be required following completion of step (k). If so, repeat steps (e) through (k) until correct calibration is achieved.

l. Set FREQUENCY dial to 0.2.

m. Set FREQUENCY RANGE selector to 10 MHz. Counter should indicate 2 MHz ±2 MHz.

n. Set FREQUENCY RANGE selector to 1 MHz. Counter should indicate 0.2 MHz ±4 kHz.

o. Set FREQUENCY RANGE selector to 100 kHz. Counter should indicate 20 kHz ±400 Hz.

NOTE: If correct calibration of unit cannot be achieved in steps (l) through (o), repeat steps (a) through (k) and if necessary repeat steps (l) through (o).

4.5 AMPLITUDE/SINE SHAPER CALIBRATION

NOTE: This procedure should be performed only if failures have occurred in the triangle shaping circuit.

a. Set FREQUENCY RANGE selector to X100 HZ.

b. Set FREQUENCY dial to 2.

c. Monitor triangular waveform at test point TP3C with oscilloscope. Adjust potentiometer R394 so that triangular waveshape is centered around zero volts dc. Check adjustment by changing position of oscilloscope INPUT COUPLING selector from AC to DC noting that no voltage level change occurs.

NOTE: Steps (d) through (f) should be accomplished only if failure has occurred in the output amplifier.

d. Monitor output of Model 420/421 on oscilloscope.

e. Set WAVEFORM selector for triangle ($\wedge\!\!\vee$) waveform.

f. Adjust potentiometer R410 to position waveform equally above/below the zero volt reference level.

4.6 SINE WAVE CALIBRATION

a. Repeat control positioning of paragraph 4.3, step (a) except that WAVEFORM selector is set to sine (∿) and FREQUENCY dial to 2.

b. Connect instrument OUTPUT 20 V P–P MAX connector through T_ connector to A channel input of oscilloscope and distortion analyzer.

c. Set distortion analyzer controls as follows:

Control	Position
FREQUENCY RANGE selector	X1
FUNCTION selector	set level
AUTO/MANUAL selector	MANUAL

d. Adjust distortion analyzer sensitivity control for full scale deflection.

e. Adjust sensitivity of distortion analyzer for 1 on scale.

f. Set distortion analyzer FUNCTION selector to DISTORTION and adjust BALANCE and FREQUENCY controls for a null. Set MODE switch to AUTOMATIC. Set METER RANGE control as required.

g. Observing oscilloscope and distortion analyzer, adjust potentiometers R302 and R305 for minimum distortion. It should be less than 0.5%. Adjust sensitivity control on distortion analyzer as required to enable optimum potentiometer adjustment.

h. If a minimum of 0.5% distortion cannot be obtained, potentiometer R14 may be adjusted for minimum distortion and potentiometer R394 may be adjusted for minimum distortion. Subsequent to these adjustments readjust potentiometers R302 and R305 as described in step (g).

i. Set instrument FREQUENCY RANGE selector and RANGE dial as indicated. Observe distortion at all positions. It should be less than 0.5%.

Selector	Position
X100 Hz	0.2
X100 Hz	2
X1 KC	2
X1 KC	0.2

j. Set instrument FREQUENCY RANGE selector and RANGE dial as indicated. Observe distortion at both positions. It should be less than 0.8%.

Selector	Dial
X10 KC	0.2
X10 KC	2

NOTE: Accomplish steps (k) through (t) for minimum distortion, if the distortion is higher than indicated in the above steps of (i) and (j).

k. Position spectrum analyzer controls as follows:

Control	Position
LOG LEVEL (Fine)	as required
VIDEO FILTER	OFF
PERSISTENCE	minimum
SCAN TRIGGER	IN
INTENSITY	turn up
LOG/LINEAR	LOG
INPUT ATTENUATION	-40 dB
LOG REF LEVEL	+10 dBm
SCAN WIDTH	0.2 megacycle
BAND WIDTH	3 kc
SCAN TIME	50 ms/div
VIDEO/EXT/LINE/ AUTO	AUTO

l. Interconnect test cable between RF INPUT connector on spectrum analyzer and OUTPUT connector on instrument. Terminate cable connection with 10X 50 ohm coaxial attenuator at spectrum analyzer.

m. Set FREQUENCY RANGE selector on instrument to 100 KC.

n. Rotate instrument FREQUENCY dial from 0.2 to 2 and observe spectrum analyzer; adjust spectrum analyzer FREQUENCY control as required for proper viewing of display. No harmonics shall be >-35 dB.

o. Position spectrum analyzer controls as follows:

Control	Position
SCAN WIDTH	2 MHz
BAND WIDTH	30 KC
SCAN TIME (per division)	5 MS
LOG REF LEVEL (fine tune)	adjust for optimum viewing

p. Set instrument FREQUENCY RANGE selector to 20 MHz.

q. Rotate instrument FREQUENCY dial from 0.2 to 2 and adjust spectrum analyzer FREQUENCY control as required for optimum viewing of display. No harmonics >-30 dB.

r. Set spectrum analyzer controls as follows:

Control	Position
SCAN WIDTH	10 MHz
BAND WIDTH	300 KC
SCAN TIME (per division)	1 MS
LOG REF LEVEL (fine tune)	as required

s. Set instrument FREQUENCY RANGE selector to 10 MHz.

t. Rotate instrument FREQUENCY dial from 0.2 to 2. Adjust FREQUENCY control on spectrum analyzer for optimum viewing of display. No harmonics >-20 dB.

4.7 SINE RESPONSE

a. Connect distortion analyzer to Model 420/421 OUTPUT 20 V P—P connector. Set FUNCTION selector to voltmeter and RANGE control to 10 V range. Terminate input to distortion analyzer with 50 ohms.

b. Set Model 420/421 FREQUENCY RANGE selector to X10 Hz and WAVEFORM selector to sine (∿). Set FREQUENCY dial to 0.5.

c. Rotate FREQUENCY dial from 0.2 to 2 and verify that amplitude change is less than ±0.1 dB to 200 Hz.

d. Set FREQUENCY RANGE selector to X1 kHz; rotate FREQUENCY dial from 0.2 to 2 and verify that amplitude change is less than +0.1 dB to 2 kHz.

e. Set FREQUENCY RANGE selector to X10 kHz; rotate FREQUENCY dial from 0.2 to 2 and verify that amplitude change is less than ±0.1 dB to 20 kHz.

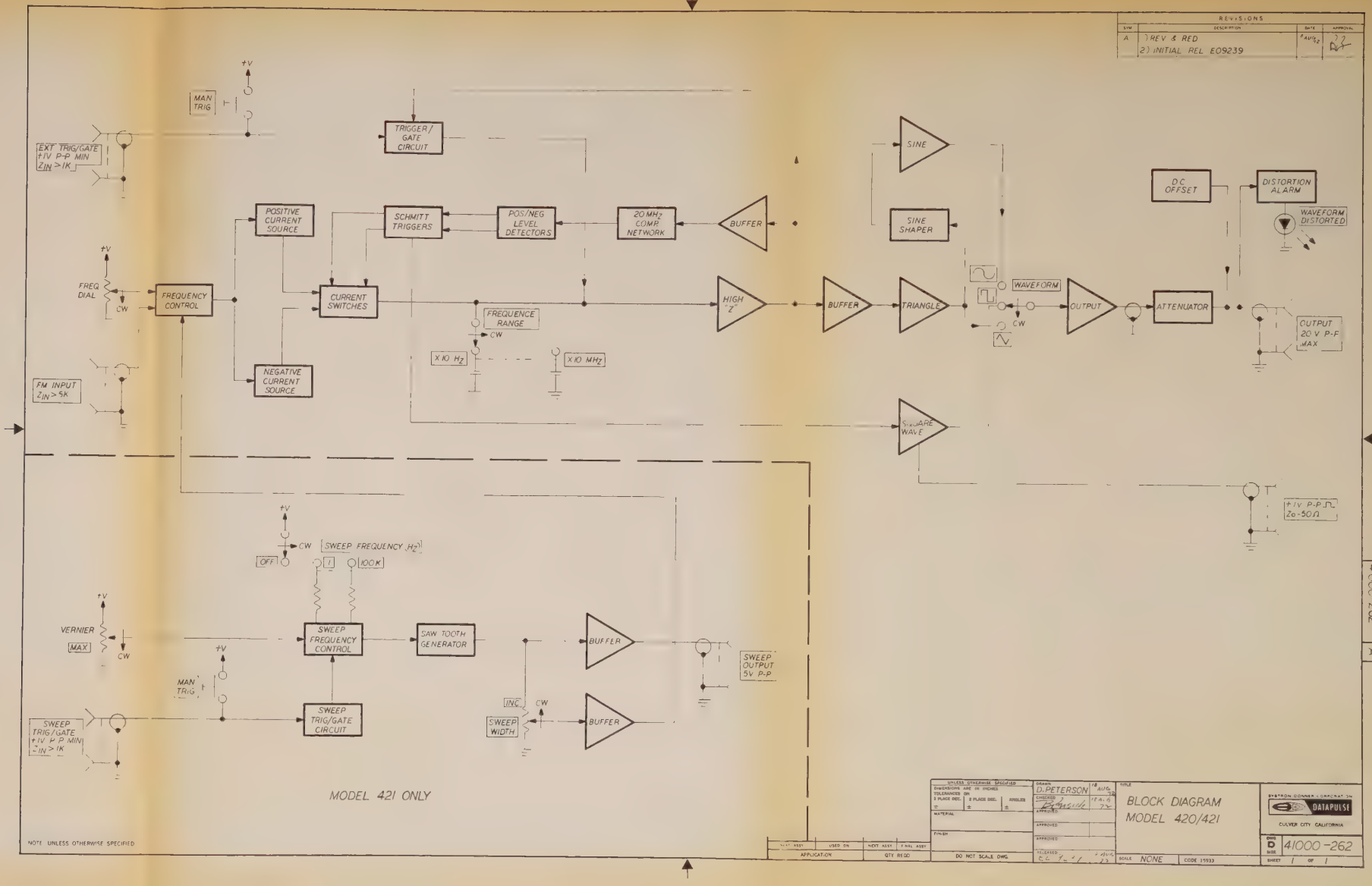
f. Set FREQUENCY RANGE selector to 100 kHz; rotate FREQUENCY dial from 0.2 to 2 and verify that amplitude change is less than ±0.1 dB to 200 kHz.

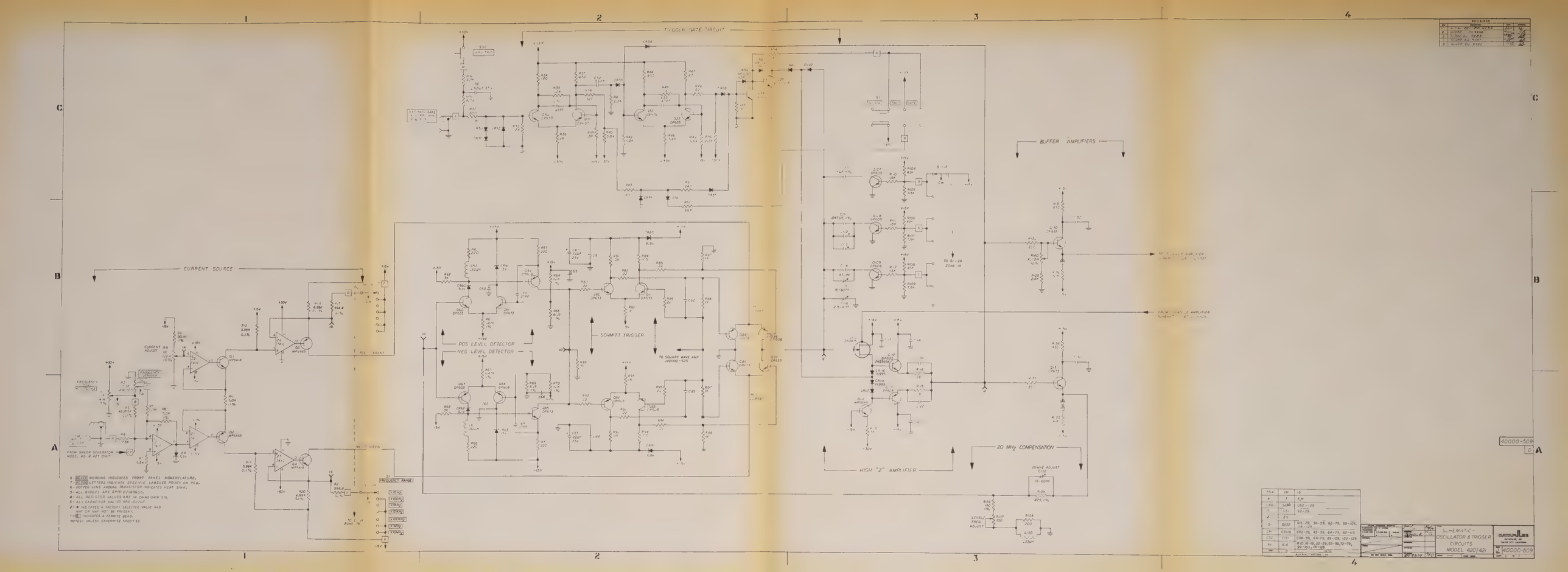
g. Disconnect distortion analyzer from Model 420/Model 421.

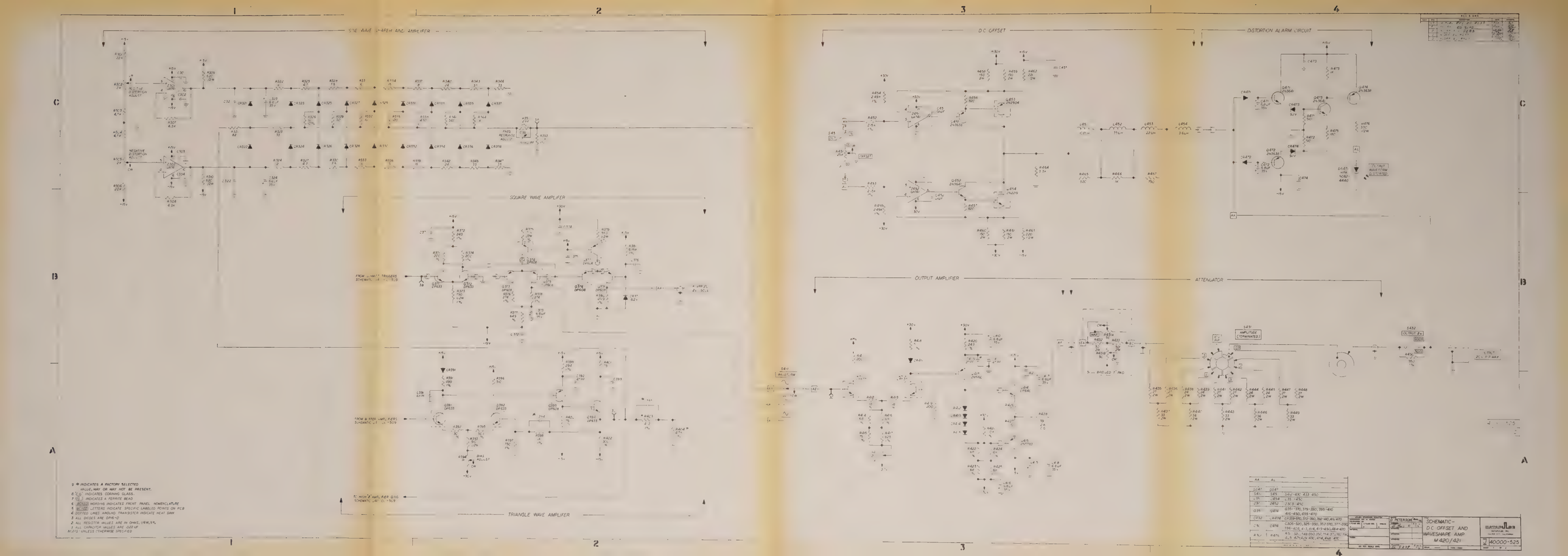
h. Connect Model 91H Voltmeter to Model 420/421 OUTPUT 20 V P–P connector.

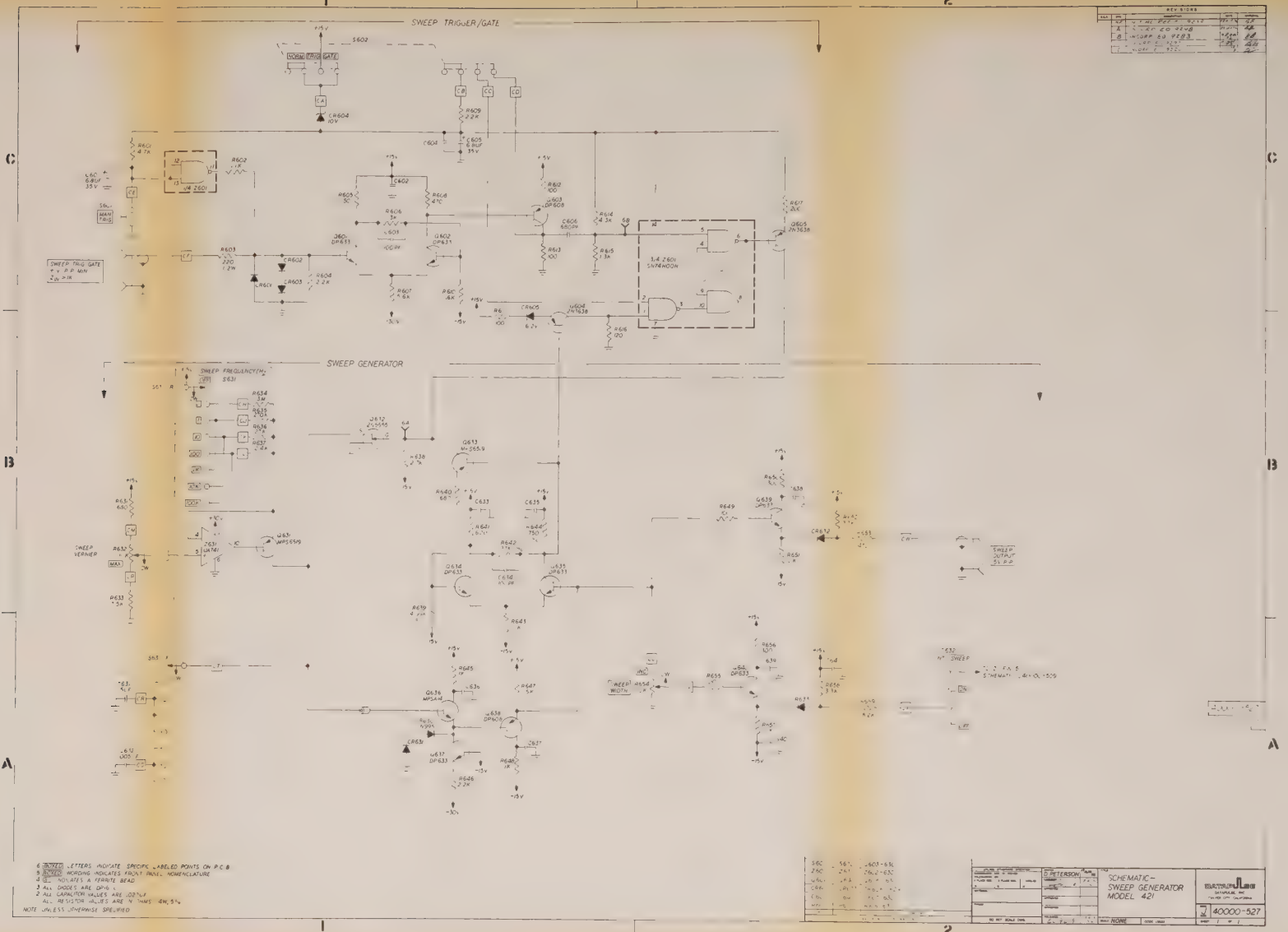
i. Set FREQUENCY RANGE selector to 1 MHz; rotate FREQUENCY dial from 0.2 to 2 and verify that amplitude change is less than ±0.1 dB to 2 MHz.

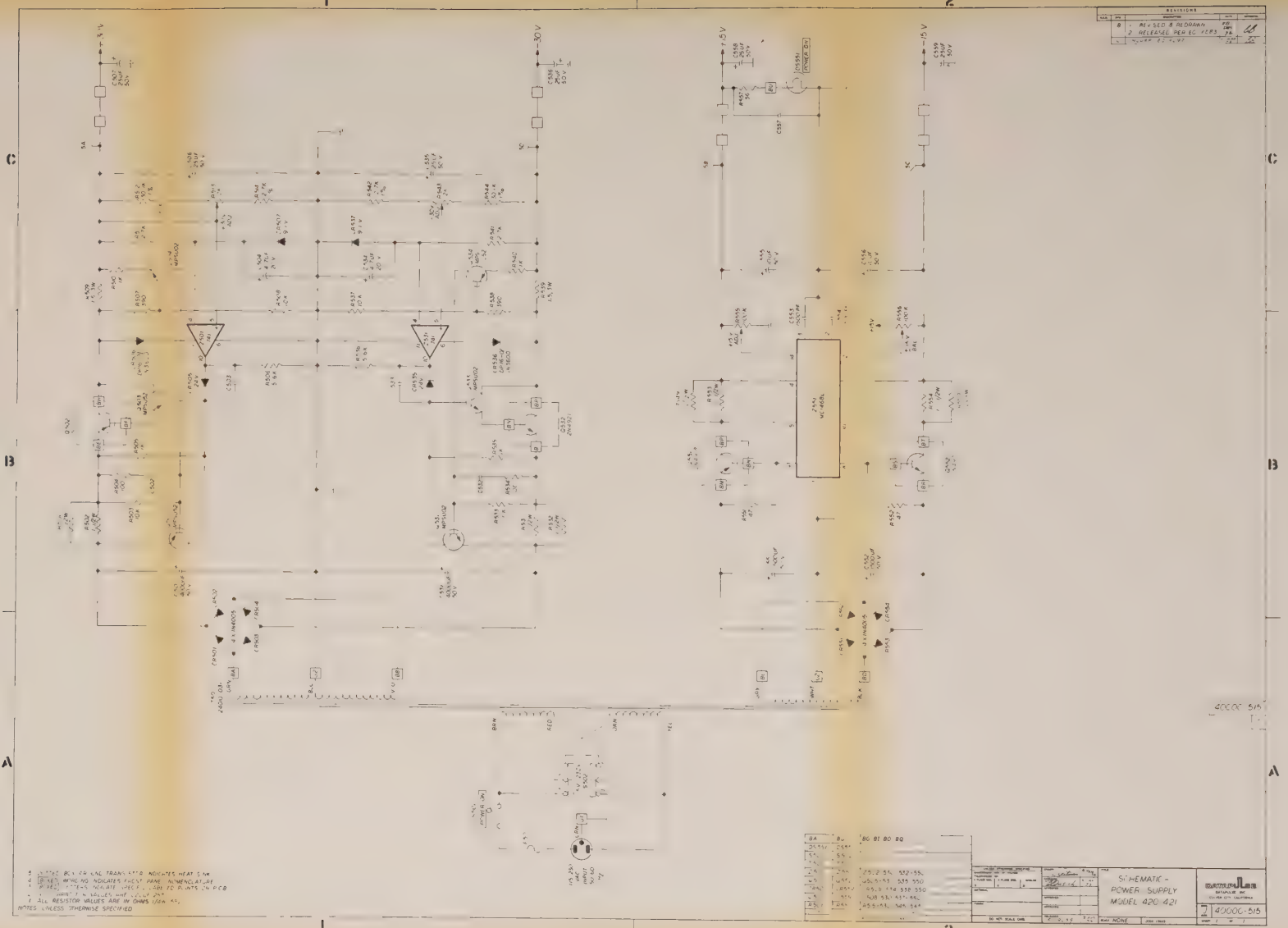
j. Set FREQUENCY RANGE selector to 10 MHz; rotate FREQUENCY dial from 0.2 to 2 and verify that amplitude change is less than ±1 dB to 20 MHz. Adjust C351 for best flatness obtainable between 0.2 to 2.

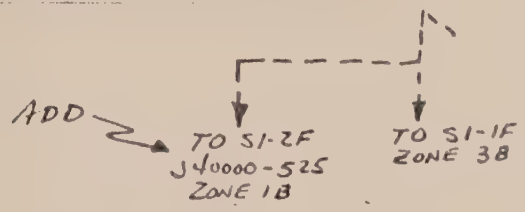

REVISIONS
A 1) REV B RED
2) INITIAL REL E09239
MAN TRIG
+V
EXT TRIG/GATE +1V P-P MIN ZIN > 1K
TRIGGER / GATE CIRCUIT
SINE
SINE SHAPER
DC OFFSET
DISTORTION ALARM
WAVEFORM DISTORTED
POSITIVE CURRENT SOURCE
SCHMITT TRIGGERS
POS/NEG LEVEL DETECTORS
20 MHz COMP NETWORK
BUFFER
FREQ DIAL
CW
FREQUENCY CONTROL
CURRENT SWITCHES
FREQUENCE RANGE
X10 Hz
X10 MHz
HIGH "Z"
BUFFER
TRIANGLE
WAVEFORM
OUTPUT
ATTENUATOR
OUTPUT 20 V P-P MAX
NEGATIVE CURRENT SOURCE
FM INPUT ZIN > 5K
SQUARE WAVE
+1V P-P Zo-50Ω
SWEEP FREQUENCY (Hz)
OFF
1
100K
VERNIER
MAX
SWEEP FREQUENCY CONTROL
SAW TOOTH GENERATOR
BUFFER
SWEEP OUTPUT 5V P-P
MAN TRIG
INC
SWEEP WIDTH
SWEEP TRIG/GATE +1V P-P MIN ZIN > 1K
SWEEP TRIG/GATE CIRCUIT
MODEL 421 ONLY
NOTE UNLESS OTHERWISE SPECIFIED
D. PETERSON
BLOCK DIAGRAM MODEL 420/421
DATAPULSE
CULVER CITY CALIFORNIA
SCALE NONE
CODE 15933
41000-262
SHEET 1 OF 1
41000-262 A


TRIGGER GATE CIRCUIT
CURRENT SOURCE
BUFFER AMPLIFIERS
POS LEVEL DETECTOR
NEG LEVEL DETECTOR
SCHMITT TRIGGER
TO SQUARE WAVE AMP 40000-525
HIGH "Z" AMPLIFIER
20 MHz COMPENSATION
FREQUENCY RANGE
TO 51-2B ZONE 1A
SCHEMATIC - OSCILLATOR & TRIGGER CIRCUITS MODEL 420/421
40000-509

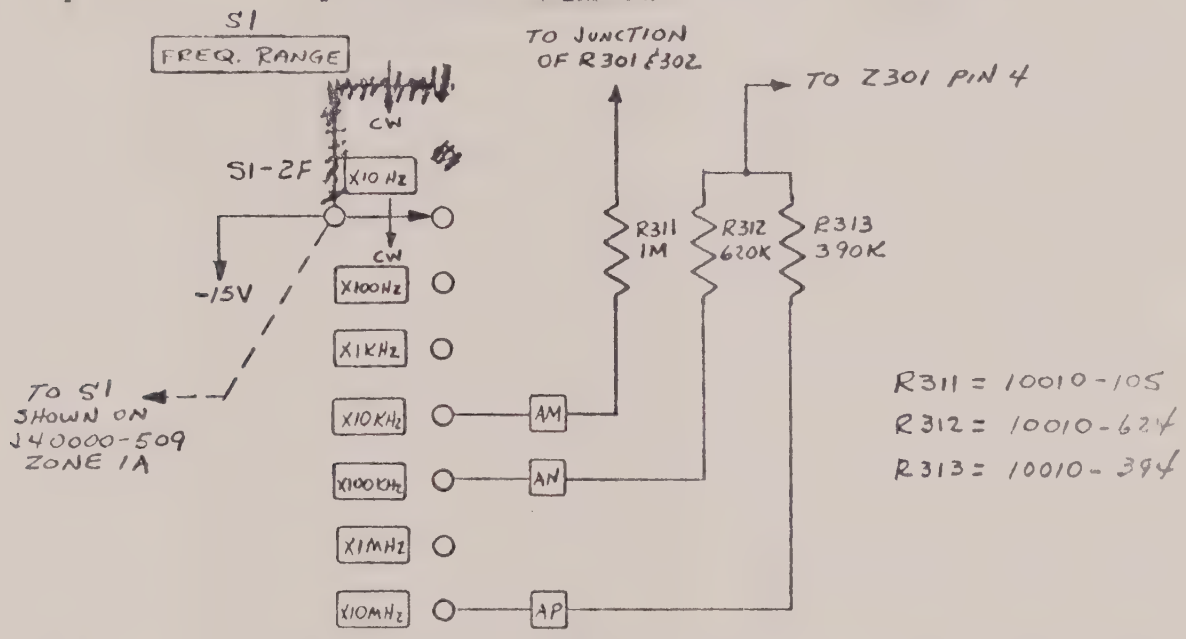

SINE WAVE SHAPER AND AMPLIFIER
DC OFFSET
DISTORTION ALARM CIRCUIT
SQUARE WAVE AMPLIFIER
OUTPUT AMPLIFIER
ATTENUATOR
TRIANGLE WAVE AMPLIFIER
9. ⊕ INDICATES A FACTORY SELECTED VALUE, MAY OR MAY NOT BE PRESENT.
6. (CG) INDICATES CORNING GLASS.
7. (FB) INDICATES A FERRITE BEAD
4. (PCB) WORDING INDICATES FRONT PANEL NOMENCLATURE
5. (PCB) LETTERS INDICATE SPECIFIC LABELED POINTS ON PCB
4. DOTTED LINES AROUND TRANSISTOR INDICATE HEAT SINK
3. ALL DIODES ARE DPI8-C
2. ALL RESISTOR VALUES ARE IN OHMS, 1/8W, 5%
1. ALL CAPACITOR VALUES ARE .022 UF
NOTES: UNLESS OTHERWISE SPECIFIED
SCHEMATIC - D.C. OFFSET AND WAVESHAPE AMP. M 420/421
40000-525


SWEEP TRIGGER/GATE
SWEEP GENERATOR
SWEEP FREQUENCY(Hz)
SWEEP VERNER
SWEEP WIDTH
SWEEP OUTPUT 50Ω
SWEEP TRIG GATE + V P.P MIN 2V > 1K
SCHEMATIC — SWEEP GENERATOR MODEL 421
D. PETERSON
40000-527
NOTE UNLESS OTHERWISE SPECIFIED


REVISIONS
B 1 REVISED & REDRAWN
2 RELEASED PER EC 1693
SCHEMATIC -
POWER SUPPLY
MODEL 420/421
40000-515

E. O. NO.	EFFECTIVE DATE	DWG. NO.	CHANGE
4471A	7-11-73	40000-509	Add R10, 47 ohm, ¼ W, 5%, P/N10010-470 between CW side of R1 and ground. Add R16, *300 k, ¼ W, 5%, P/N10010-304 across R12. Add R17, *300 k, ¼ W, 5%, P/N10010-304 across R13. Add the following to S1—2R:  Add R72, 4.7 k, ¼ W, 5%, P/N10010-472 from C-Q60 to -15 V. Add R73, 4.7 k, ¼ W, 5%, P/N10010-472 from C-Q63 to +15 V. Add R29, *51 k, ¼ W, 5%, P/N10010-513 across R35. Change R36 from ¼ W to 1 W, P/N10012-202. Change C32 from 56 pF to 22 pF, P/N11077-220. Change CR34 from DP16-0 to 1N995, P/N12144-003. Change R44 from 430 ohm to 300 ohm, P/N10010-301. Change C33 from 47 pF to 39 pF, P/N11077-390. Add R55, *15 k, ¼ W, 5%, P/N10010-153 across R49. Change R49 from 1.6 k to 1.5 k, P/N10010-152. Delete CR39 and CR40. Add R56, 470 ohm, ¼ W, 5%, P/N10010-471 and C34, 47 pF, P/N11077-470 in parallel between C-Q34 and B-Q35. Add R57, 10 k, ¼ W, 5%, P/N10010-103 from B-Q35 to -15 V. Change Q34 and Q35 from 2N3641 to DP633, P/N22635-003. Change CR41 from DP16-0 to 1N995, P/N12144-003. Add asterisk (*) to CR42. Change C116 from 2.5—11 pF to 9—35 pF, P/N11307-350. Delete CR118 and replace with jumper. Add R116, 160 ohm, ¼ W, 5%, P/N10010-161, between C Q112 and +15 V. Add R117, 160 ohm, ¼ W, 5%, P/N10010-161, between C Q113 and -15 V. Change R129 from 2.4 k to 1 k, P/N10010-102.. Change reference designation block in omitted section

E. O. NO.	EFFECTIVE DATE	DWG. NO.	CHANGE
4471A (cont.)			to read: R18, R19, R22–R28, R58, R59, R74–R79, R99–R103, R118–R128, C35–C59, C66–C79, C86–C109, C122–C129, CR2–CR29, CR39, CR40, CR43–CR59, CR64–CR79, CR82–CR115, CR118.
		40000-525	Add the following:



			Change R303 from 4.7 k to 3.9 k, P/N10010-392. Change R304 from 4.7 k to 3.9 k, P/N10010-392. Change R458, R459, R460 and R461 from 150 ohm to 130 ohm, P/N10013-131. Change reference designation block in omitted section from R311–R320 to R314–R320. and from last used AL to AP and add AG, AI, AO.
		40000-527	Add asterisk to CR630. Add note 7: Asterisk (*) indicates a factory selected value and may or may not be present.
4496	8 22 73	40000-509	Change R72 and R73 from 4.7 k, ¼ W, 5%, P/N10010 472 to 20 k, ¼ W, 5%, P/N10010-203. Change Q84 and Q86 from DP608, P/N22605-008 to MPS6519, P/N12605-018. Change Q85 and Q87 from DP633, P/N22635-003 to MPS6515, P/N12645-016. Delete R62 and R68, 3 k, P/N10010-302.
		40000-525	Change R303 and R304 from 3.9 k, ¼ W, 5%, P/N 10010-392 to 3.3 k, ¼ W, 5%, P/N10010-332. Change R415 from 750 ohm, ¼ W, 1%, P/N10710-751

E. O. NO.	EFFECTIVE DATE	DWG. NO.	CHANGE
4496 (cont.)			to 681 ohm, ¼ W, 1%, P/N10710-681 Change R417 from 825 ohm, ¼ W, 1%, P/N10710-821 to 681 ohm, ¼ W, 1%, P/N10710-681. Remove jumper from CR41 anode to CR116 cathode.
4509	8-25-73	40000-527	Change R652 from 3.3 k, ¼ W, 5%, P/N10010-332 to 2 k, ¼ W, 5%, P/N10010-202.
4521	9-7-73	40000-525	Install on circuit side of output board a DP640, P/N22645-000 with the base and collector in parallel with Q414 and the emitter lead going to a 20 ohm resistor, P/N10010-200, connect the other side of the 20 ohm resistor to the junction of R426 and R428. Install a 2N5583, P/N12605-019 and a 20 ohm resistor, P/N10010-200 in the same manner as the above instruction, but with the transistor in parallel with Q415. Change R426 and R427 from 10 ohm, P/N10010-100 to 20 ohm, P/N10010-200. Install heat sinks, P/N15550-145 to above added transistors. Change C411 from 47 pF, P/N11078-470 to 56 pF, P/N11078-560. Note: DP638 may be used in place of DP640. Change R418 from 511 ohm, 1%, 1/8 W, P/N10690-511 to a 221 ohm, 1%, ¼ W, P/N10710-221 in series with a 294 ohm, 1%, ¼ W, P/N10710-291. Change R414 and R416 from 681 ohm, ¼ W, 1%, P/N10710-681 to 560 ohm, 1 W, 5%, P/N10722-561. Change R415 from 750 ohm, ¼ W, 1%, P/N10710-751 to 560 ohm, 1 W, 5%, P/N10722-561. Change R417 from 825 ohm, ¼ W, 1%, P/N10710-825 to 560 ohm, 1 W, 5%, P/N10722-561. Change R422, R423, R424 and R425 from 681 ohm, ¼ W, 1%, P/N10710-681 to 680 ohm, 1 W, 5%, P/N10722-681. Change R420 from 243 ohm, ¼ W, 1%, P/N10710 241 to 240 ohm, 1 W, 5%, P/N10722-241. Change R458, R459, R460 and R461 from 130 ohm, 2 W, 5%, P/N10013-131 to 130 ohm, 3 W, 5%, P/N10754-131. Change Q453 from 2N2904A, P/N12605-002 to 2N4918, P/N12616-000. Note: To be mounted on side bracket next to where Q453 was before. The bracket has a hole, but not the circuit board. Drill hole through circuit board. Change Q454 from 2N2219A, P/N12645-002 to 2N4921, P/N12666-000. Note: To be mounted on side barcket @ 6½" from front panel.

E. O. NO.	EFFECTIVE DATE	DWG. NO.	CHANGE
4521 (cont.)			Add a 47 pF Dip Mica capacitor, P/N11077-470 across C351 (mounted on circuit side of board.
4540	10-2-73	40000-527	Change Q640 from DP633, P/N22635-003 to MPS A14, NPN, P/N12775-000. Add diode CR634, 1N995, P/N12144-003 in series with CR633 (from cathode of CR633 to the emitter of Q640, cathode to the emitter of Q640). Add asterisk to R639, R642, R643, R644 and R658. Change R643 from 1.1 k, 5% to 1 k, ¼ W, 1%, P/N10710-102.
		40000-509	Change Z1, Z2, Z3, Z4 and Z5 from 741C, P/N12903-000 to MC1741SCP1, P/N12903-013.

DATAPULSE DIVISION
SYSTRON DONNER

SEMICONDUCTOR REPLACEMENTS
(Applicable to all Datapulse Models except the Model 102.)

SERVICE BULLETIN 1-65
Revised 8-13-73

The listed commercial diodes and transistors may be suitable replacements for the corresponding Datapulse parts, either as direct substitutes, or as selected for the special performance characteristics given. In certain cases, it may be necessary to use the Datapulse parts.

DATAPULSE TYPE NO.	DATAPULSE PART NO.	COMMERCIAL EQUIVALENT
Diodes:		
DP15-0	22154-000	1N752A selected for $\Delta V < 0.2$ V between 7 mA and 110 mA.
DP15-1	22154-001	Same as DP15-0 but matched in pairs to within 0.1 V.
DP15-201	22154-201	1N936 selected for 9.4 V $\pm$0.1 V @25 mA.
DP16-0	22164-000	1N3600
DP16-1	22164-001	(>80 V, DP16-0)
DP19-0	22194-000	1N2070/1N4005
DP19-6	22194-006	1N2071/1N4005
Transistors:		
DP46-1	22465-001	Selected for h_{fe} = 100 min.
DP59-0	22595-000	2N2904A
DP60-1	22605-001	2N2894 selected for V_{ceo} (sust) = 20 V min.
DP60-2	22605-002	2N3133
DP60-4	22605-004	2N3209
DP60-5	22605-005	FT1702
DP60-6	22605-006	2N3640
DP60-7	22605-007	2N2894 selected for V_{ceo} (sust) = 25 V
DP60-8	22605-008	2N2894A (Motorola) V_{ceo} >20
DP63-2	22635-002	Replaced by DP63-3
DP63-3	22635-003	2N2369A (Fairchild) h_{fe} >70
DP63-4	22635-004	Replaced by DP63-3
DP63-6	22635-006	2N2219A
DP63-8	22635-008	May be replaced by 2N5109 selected for $h_{fe} \geq 20$ @I_c = 0.25 A & V_c = 2.5 V
DP63-9	22635-009	May be replaced by 2N5109 selected for $h_{fe} \geq 20$ @I_c = 0.25 A & V_c = 2.5 V
DP64-0	22645-000	May be replaced by 2N5109 selected for $h_{fe} \geq 20$ @I_c = 0.25 A & V_c = 2.5 V

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